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SPECIFICATION

OF

WILLIAM NAYLOR.

CONSUMING SMOKE.

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A.D. 1866, 20th MARCH. N^o 821.

Consuming Smoke.

LETTERS PATENT to William Naylor, of Lorn Terrace, Mildmay Park, in the County of Middlesex, Mechanical Engineer, for the Invention of
“IMPROVEMENTS IN THE PREVENTION OR CONSUMPTION OF SMOKE.”

Sealed the 18th September 1866, and dated the 20th March 1866.

PROVISIONAL SPECIFICATION left by the said William Naylor at the Office of the Commissioners of Patents, with his Petition, on the 20th March 1866.

I, WILLIAM NAYLOR, of Lorn Terrace, Mildmay Park, in the County of Middlesex, Mechanical Engineer, do hereby declare the nature of the said Invention for “IMPROVEMENTS IN THE PREVENTION OR CONSUMPTION OF SMOKE,” to be as follows :—

This Invention has for its object the prevention or consumption of the smoke heretofore evolved from reverberatory, puddling, re-heating, and air
10 furnaces, and consists according to one method of carrying out my Invention in forming an air chamber or chambers or conduit or conduits along the neck and roof or sides or bottom of furnaces of the above description, the inner side of such chambers or conduits being divided from the interior of the furnace or neck of the furnace by a thin slab of fire-brick or other good
15 refractory material, in order that as much heat as possible may be imparted to the air therein. One end of these conduits or chambers nearest the stack or chimney is connected to an air inducer, which consists of a pipe provided with

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one or more steam jets, and with an orifice for the admission of air, such orifice being provided with a self-acting valve, which is sufficiently weighted to close or nearly close when the steam jets are not on, but to open by the inrush of air to the pipe when the steam jets are applied. The opposite end of this pipe separates into two branches, the one branch being connected to 5 the mouth of the hot air conduit or chamber above referred to, so as to convey air thereto, whilst the other branch is connected to an inverted syphon which is partly filled with water, such syphon serving to collect and carry off any water of condensation which may be produced in the pipe, and thereby prevent it from being blown into the hot air chamber or conduit. By this 10 means a powerful current of air is caused to pass through the hot air chambers or conduits, and such air after being highly heated in its passage through the said chambers or conduits enters the furnace through apertures for that purpose, and mixes with the unconsumed gases as they rise from the fresh fuel, thereby effecting their combustion and preventing the formation of 15 smoke. In some cases the air branch of the pipe or air inducer above described may be made to inject the air directly into the chimney or stack, either at the bottom thereof, or through openings made for that purpose in the sides at any desired height above the ground, by which means a powerful blast is produced up the chimney or stack, the object being to compensate for 20 the retardation of the draught produced by the cooling effects of the air in the chimney by imparting increased velocity to such air. In lieu of steam jets other well-known means may be employed for producing a current of air, as for example, a fan blower, bellows, or blowing cylinder. As the inlet of air into the furnace or stack is only required during the time that the fuel is 25 giving out unconsumed gases, which would otherwise result in smoke, I propose to adopt suitable self-acting arrangements for closing or partially closing the air inlets and the steam jets (when employed), such arrangements being so disposed that before the mouth of the feeding aperture of the furnace can be opened for the admission of fuel the air inlets and steam jets (when 30 used) shall be opened or brought into play. One mode of effecting this consists of a lever working on a fulcrum, and carrying at one end a dead weight, whilst at its opposite end it carries a bucket or vessel which rises and falls in a cistern of water, such vessel having a perforation in the bottom. The dead weight preponderates slightly over the bucket or vessel when empty, and 35 when the lever is in its normal position and no air is admitted to the furnace the weight will be immediately in front of a flap or grating covering the mouth of the feed aperture, and consequently all access to the furnace is prevented until the weighted end of the lever is lifted out of the way, so as to

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admit of the flap being opened. A notch in the weight receives the edge of the door or flap when opened, and holds it in that position whilst the fuel is being thrown in. In the meantime the bucket by being lowered into the cistern is partially filled with water, and when the furnace door or flap is
5 closed and the weight thereby released, its gravity tends to cause the lever to turn slowly upon its fulcrum, lifting at the same time the partially filled bucket partly out of the water in the cistern, and as the water flows out of the bucket through the hole in the bottom the weighted end of the lever gradually descends to its normal position opposite to the flap. This motion of the lever
10 when released is conveyed to the air inlet valves, or to cocks or valves on the steam jet pipes, and effects their gradual closing, the opening of the same being effected by the lifting of the lever preparatory to the opening of the door or flap in front of the furnace charging mouth ; or, if preferred, in the case of a fan blower, bellows, or cylinder blower the gradual descent of
15 the weighted end of the lever may be made to transfer the driving strap of such blowers to a loose pulley on a driving shaft, whilst by lifting the lever the strap is put on to the fast pulley, and the blower set in motion so as to produce the current of air at the desired time. The duration of the period during which the air is to be admitted into the furnace may be varied
20 according to the length of time necessary for the fresh fuel to give off its gases by increasing or diminishing the size of the aperture in the bottom of the bucket, so as to allow the water to flow therefrom quicker or slower as required.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed
25 by the said William Naylor in the Great Seal Patent Office on the 20th September 1866.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, WILLIAM NAYLOR, of Lorn Terrace, Mildmay Park, in the County of Middlesex, Mechanical Engineer, send greeting.

30 **WHEREAS** Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twentieth day of March, in the year of our Lord One thousand eight hundred and sixty-six, in the twenty-ninth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said William Naylor, Her special license that I, the said William Naylor, my
35 executors, administrators, and assigns, or such others as I, the said William Naylor, my executors, administrators, or assigns, should at any time agree

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with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN THE PREVENTION OR CONSUMPTION OF SMOKE," upon the condition (amongst 5 others) that I, the said William Naylor, my executors or administrators, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the 10 said Letters Patent.

NOW KNOW YE, that I, the said William Naylor, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the accompanying Drawings, and to the 15 letters and figures marked thereon, that is to say:—

My said Invention has for its object the prevention or consumption of the smoke heretofore evolved from reverberatory, puddling, re-heating, and air furnaces, and consists according to one method of carrying out my Invention in forming an air chamber or chambers or conduit or conduits along the neck and 20 roof or sides or bottom of furnaces of the above description, the inner side of such chambers or conduits being divided from the interior of the furnace or neck of the furnace by a thin slab of fire-brick or other good refractory material, in order that as much heat as possible may be imparted to the air therein. One end of these conduits or chambers nearest the stack or chimney is connected 25 to an air inducer, which consists of a pipe provided with one or more steam jets, and with an orifice for the admission of air, such orifice being provided with a self-acting valve, which is sufficiently weighted to close or nearly close when the steam jets are not on, but to open by the inrush of air to the pipe when the steam jets are applied. The opposite end of this pipe separates 30 into two branches, the one branch being connected to the mouth of the hot air conduit or chamber above referred to, so as to convey air thereto, whilst the other branch is connected to an inverted syphon which is partly filled with water, such syphon serving to collect and carry off any water of condensation which may be produced in the pipe, and thereby prevent it from being blown 35 into the hot-air chamber or conduit. By this means a powerful current of air is caused to pass through the hot air chambers or conduits, and such air after being highly heated in its passage through the said chambers or conduits enters the furnace through apertures for that purpose and mixes with the

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unconsumed gases as they rise from the fresh fuel, thereby effecting their combustion and preventing the formation of smoke. In some cases the air branch of the pipe or air inducer above described may be made to inject the air directly into the chimney or stack, either at the bottom thereof or through
5 openings made for that purpose in the sides at any desired height above the ground, by which means a powerful blast is produced up the chimney or stack, the object being to compensate for the retardation of the draught produced by the cooling effects of the air in the chimney by imparting increased velocity to such air. In lieu of steam jets other well-known means may be employed
10 for producing a current of air, as for example, a fan blower, bellows, or blowing cylinder. As the inlet of air into the furnace or stack is only required during the time that the fuel is giving out unconsumed gases, which would otherwise result in smoke, I propose to adopt suitable self-acting arrangements for closing or partially closing the air inlets and the steam jets (when
15 employed), such arrangements being so deposited that before the mouth of the feeding aperture of the furnace can be opened for the admission of fuel the air inlets and steam jets (when used) shall be opened or brought into play. One mode of effecting this consists of a lever working on a fulcrum, and carrying at one end a dead weight, whilst at its opposite end it carries a
20 bucket or vessel which rises and falls in a cistern of water, such vessel having a perforation in the bottom; the dead weight preponderates slightly over the bucket or vessel when empty, and when the lever is in its normal position and no air is admitted to the furnace the weight will be immediately in front of a flap or grating covering the mouth of the feed aperture, and consequently all
25 access to the furnace is prevented until the weighted end of the lever is lifted out of the way, so as to admit of the flap being opened. A notch in the weight receives the edge of the door or flap when opened, and holds it in that position whilst the fuel is being thrown in. In the meantime the bucket by being lowered into the cistern is filled or partially filled with water, and when the
30 furnace door or flap is closed, and the weight thereby released, its gravity tends to cause the lever to turn slowly upon its fulcrum, lifting at the same time the filled or partially filled bucket partly out of the water in the cistern, the height to which the bucket will be raised, and the consequent difference in level between the water in the bucket and that in the cistern will
35 depend upon the amount of preponderance of the weight over the empty bucket, and as the water flows out of the bucket through the hole in the bottom the weighted end of the lever gradually descends to its normal position opposite to the flap. This motion of the lever when released is conveyed to the air inlet valves, or to cocks or valves on the steam jet pipes, and effects

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their gradual closing, the opening of the same being effected by the lifting of the lever preparatory to the opening of the door or flap in front of the furnace charging mouth. Or, if preferred, in the case of a fan blower, bellows, or cylinder blower the gradual descent of the weighted end of the lever may be made to transfer the driving strap of such blowers to a loose pulley on a 5 driving shaft, whilst by lifting the lever the strap is put on to the fast pulley, and the blower set in motion so as to produce the current of air at the desired time. The duration of the period during which the air is to be admitted into the furnace may be varied according to the length of time necessary for the fresh fuel to give off its gases by increasing or diminishing the size of the 10 aperture in the bottom of the bucket, so as to allow the water to flow therefrom quicker or slower as required.

And in order that my said Invention may be fully understood I shall now proceed more particularly to describe the same, and for that purpose shall refer to the several Figures on the annexed Sheet of Drawings, the same 15 letters of reference indicating corresponding parts in all the Figures.

Figure 1 of my Drawings represents a longitudinal vertical section of a heating or re-heating furnace with my improvements for effecting the consumption of smoke applied thereto; Figure 2 is a corresponding sectional plan of the same; and Figure 3 is an end elevation thereof. 20

In my Drawings I have shown, for the sake of convenience, the adaptation to one furnace of 3 different modes of effecting the same object, but it is to be understood that these are alternative modes only, and that in practise only one of such modes will be applied to a furnace, selecting that one which may be found best adapted to the nature of the furnace to which it is to be 25 applied.

A is the body of an ordinary heating or re-heating furnace, provided with the usual fire-place B, and opening at the neck into the chimney C. According to one arrangement, with a view to the prevention of smoke; and to the effecting a more economical and perfect combustion of the fuel, I 30 construct an air chamber or conduit D along the neck and roof of the furnace, as shown in Figure 1 of my Drawings, or, if preferred, along the sides or bottom, or such air chamber may be formed along both sides, roof, and bottom if found desirable. This conduit or air chamber is separated from the heating chamber A of the furnace by their fire-clay tiles E in order that a 35 considerable degree of heat may be imparted to the air during its passage along the said air chamber or conduit. At the front end of the furnace, or that end where the fire-place is situate, I make a number of small openings or perforations F in the lining of the furnace which communicate with the

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air chamber or conduit D, and admit of the air which has been heated by its passage through such conduit or conduits to enter the fire-place just above the fresh fuel in a number of small streams or jets, as shewn by the arrows, and be ultimately admixed with the gaseous products of combustion as they
5 are evolved from the fuel so as to insure their ignition. Atmospheric air is forced into the conduit D through the pipe G, either by the aid of a fan or other blower in connection with such pipe, or the air may be induced therein by the aid of a steam jet or jets, as illustrated in my Drawings. In the latter case I provide the pipe G with an air inlet valve H on one side,
10 opening inwards by the inrush of air, and I introduce steam into the end of such pipe through the steam pipe I. This steam is subdivided into a number of small jets by means of a series or group of small pipes or nozzles *a* fitted to a tube plate between the cap *b* and the end of the tube. The pipe G passes direct to a bend or inverted syphon K, which contains a column of
15 water sufficiently high to prevent the escape of steam and air, whilst it at the same time allows the condensed steam to flow off. A lateral branch G¹ from the pipe G enters the roof of the furnace and communicates with the air conduit D as shown in Figures 1 and 2; this branch is curved upwards from the pipe G so as to prevent the entrance of water or moisture into the
20 branch G¹, and thence into the conduit D, any water of condensation forming in the pipe G being blown directly down such pipe into the bend or syphon K, and flowing off as fast as it collects. In lieu of inducing or forcing air into an air conduit or conduits D, and causing such air when heated to enter the front of the furnace through perforations F, I sometimes introduce one or
25 more jets of air into the bottom of the shaft or chimney, either by the aid of a fan or other blower or by the aid of steam jets, which latter I prefer. This arrangement is clearly illustrated in Figures 1 and 2 of my Drawings, where L represents the air supplying pipe provided with an air valve and steam jet nozzle or pipes precisely similar to those herein-before described in reference
30 to the pipe G which supplies the hot air conduit D; this pipe is curved upwards and forms a jet or nozzle at M, which is situate at the bottom of the shaft or chimney C, so that the air may be directed up the interior thereof. At the bend of this pipe a communication is established by making a slot therein with the syphon pipe N, which, like the bend or syphon K, is kept
35 supplied with water for the purpose already described. In order to subdivide the jet of air I place a perforated fire-brick or slab O acrosss the chimney and above the nozzle M, and with a view to preventing such perforations from becoming clogged up with slag, and so obstructing the inlet of air to the chimney, I make a pocket or recess P in the floor of the neck of the furnace

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for the purpose of collecting such slag, whence it may be removed as required through a lateral opening for that purpose. In puddling furnaces, where it is desirable to economise the waste heat by heating the pig iron at the bottom of the chimney before introducing it into the puddling chamber, I make the slab O solid or without perforations and cause the air to pass upwards along 5 passages Q, Q, shown in dotted lines, made in the sides of the chimney and opening into the interior of the chimney from the sides thereof at any desired elevation, as shown by the dotted arrows in Figure 1, in which case the air will be heated before entering the chimney. As in all these arrangements it is only necessary to admit the currents of air, whether heated or otherwise, 10 during a short period after a charge of fresh fuel has been thrown into the furnace, I propose to adopt a self-acting contrivance for shutting off the air and steam jets when no longer required. One form of this contrivance is illustrated by Figure 3 of my Drawings, where R represents the fuel feeding aperture, and S a slide guided in cheeks in the casting R, such weight 15 when in its lowest position resting upon the dead plate and obstructing the entrance to the furnace. This weight is connected by a chain with one end of a lever T, the opposite end of which is similarly connected to a bucket U contained in a cistern of water V. A small aperture is made in the bottom of this bucket, and a larger opening is also formed therein, which is closed by 20 a flap or other self-acting valve C opening inwards to the bucket. When the attendant has to throw in a charge of fuel he must first elevate the weight S, in doing which he depresses the bucket U, causing it to sink into the cistern V, the water in which enters the bucket through the valve c, and by its weight keeps the slide S elevated during a sufficient period of time for accom- 25 plishing the introduction of the fuel. As the weight of the slide S, however, tends to lift the bucket the water will slowly flow out therefrom into the cistern again through the small aperture made for that purpose, and the lever by canting over slowly to its original position will lower the slide S, and will at the same time, if suitable connections be established between the lever 30 and the steam or air valves, which will be obvious to the practical engineer, gradually close such valves, and thereby reduce and finally arrest the further supply of air; or in the case of using a fan or blower the canting of the lever may be made to shift the driving strap of the air-forcing apparatus from one pulley to the other, and so start and stop such apparatus at the desired 35 time.

Having now described and particularly ascertained the nature of my said Invention, and the manner in which the same is or may be used or carried into effect, I would observe in conclusion that what I consider to be novel

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and original, and therefore claim as the Invention secured to me by the herein-before in part recited Letters Patent is,—

First, the general construction, arrangement, and combination of apparatus or means for effecting the consumption of smoke in reverberatory and other
5 like furnaces, substantially as herein-before described.

Second, the admission of one or more jets of air to the interior of reverberatory and other like furnaces from hot air chambers or conduits formed in the neck and roof or bottom or sides of such furnaces, substantially as and for the purpose herein-before described.

10 Third, the admission of one or more jets of air into the bottom or through the sides of the chimney shafts of reverberatory and other like furnaces, substantially as and for the purpose herein-before described.

Fourth, the peculiar arrangement of apparatus for inducing air by the aid of steam jets into reverberatory and other like furnaces, or into the chimneys
15 thereof, and for collecting and carrying off the water of condensation, as herein-before described.

Fifth, the peculiar arrangement of self-acting contrivances for stopping the supply of the air jets to reverberatory and other like furnaces at the proper periods, as herein-before described.

20 In witness whereof, I, the said William Naylor, have to this my Specification set my hand and seal, the Nineteenth day of September, One thousand eight hundred and sixty-six.

WM. NAYLOR. (L.S.)

LONDON:

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